

# **Collaboratory Life: Factors Influencing Success in Research Collaboratories**

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**WACE 2003, Seattle**



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# Principals

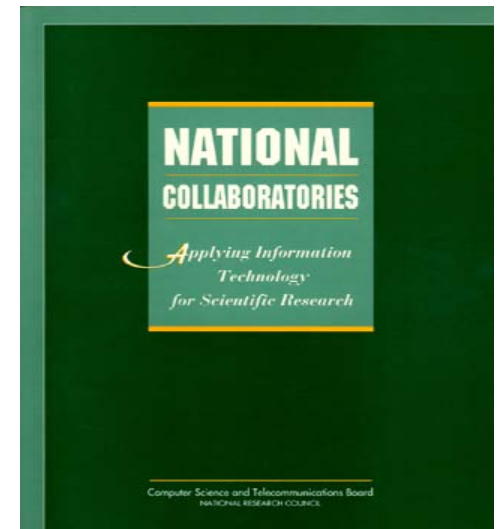
- G. Olson, PD
- J. Olson
- N. Bos
- S. Teasley
- T. Finholt
- J. Hardin
- D. Cogburn
- D. Atkins

- M. Hedstrom
- E. Yaker
- P. Knoop
- E. Hofer
- D. Cooney
- J. Herbsleb (CMU)
- J. Trimble (Howard)
- Zillions of grad students
  
- G. Furnas
- J. King
- M. Cohen
- D. Radev



# The Collaboratory Concept

- **Collaboratory** <-- Collaborate + Laboratory
- W. Wulf -- “... a ‘**center without walls,**’ in which the nation’s researchers can perform their research without regard to geographical location” (1989)
- Many collaboratory initiatives
  - NSF, NIH, DOE, NASA, etc.



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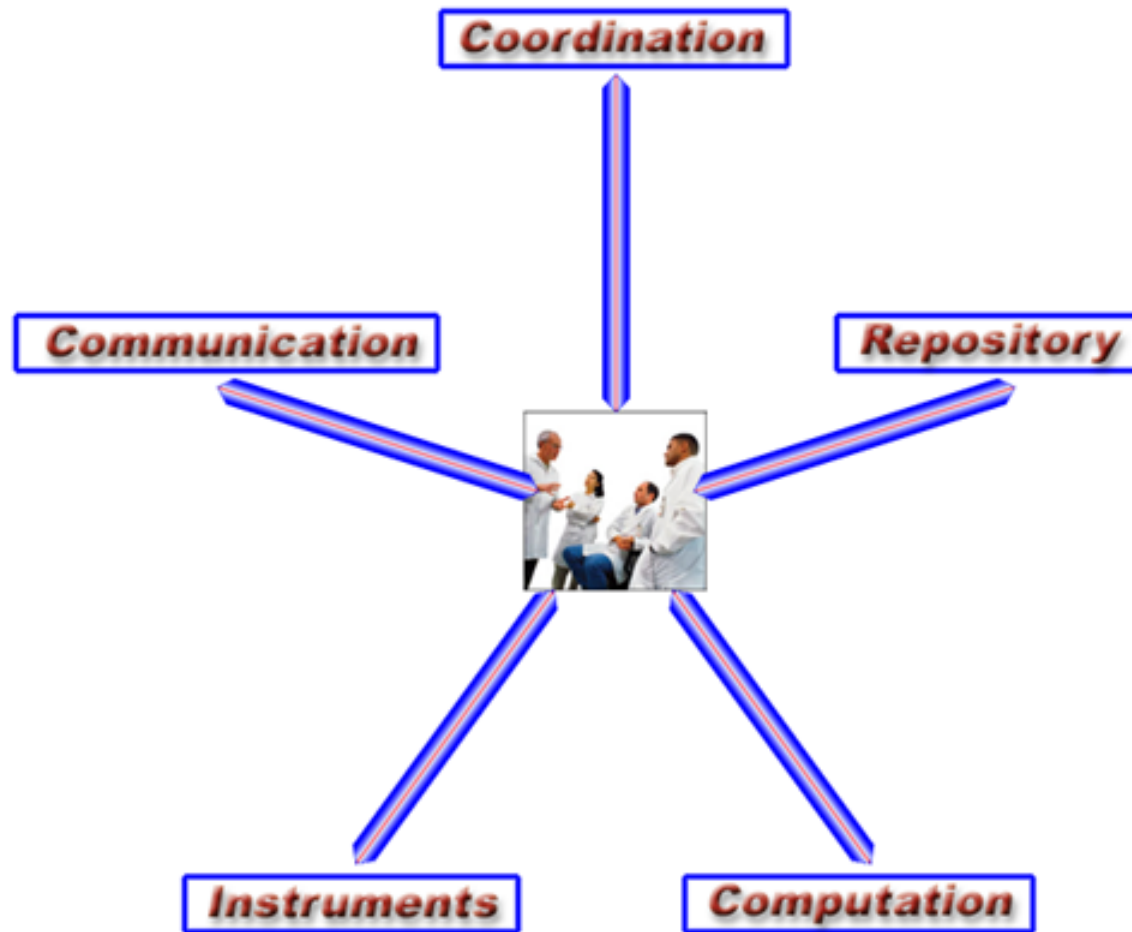


# Definition of a Collaboratory

- A collaboratory is an organizational entity that **spans distance**, supports rich and recurring **human interaction** oriented to a **common research area**, and provides **access** to data sources, artifacts and tools required to accomplish research tasks.



# Components of collaboratories



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# Science of Collaboratories Project

- Perform a comparative analysis of collaborative projects
- Develop general principles and design methods
- Test these principles on existing or upcoming collaboratories
- Develop of a Collaboratory Knowledge Base
  - technical and social data and detailed findings from existing collaborative projects




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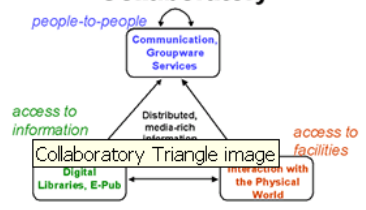
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### Science of Collaboratories Home

For more than a decade a number of collaboratory projects have been carried out in a variety of scientific and engineering fields. Most collaboratories have been built as one-off, hand-crafted projects. We seek to change this. The Science of Collaboratories (SOC) project is devoted to understanding the technical and behavioral principles that can lead to better, more successful design of collaboratories in the future. Please explore this web site to learn more about:

- the SOC project [overview](#),
- our [mission](#)
- the project [activities](#)
- the [partner organizations](#) involved
- the [research team](#)
- and, as the project proceeds, [our findings and results](#).


**Collaboratory**





The diagram illustrates the 'Collaboratory Triangle' with three interconnected components:

- Top:** Communication, Groupware, Services (labeled 'people-to-people' with a double-headed arrow).
- Bottom Left:** Digital Libraries, E-Pub (labeled 'access to information' with a double-headed arrow).
- Bottom Right:** Interaction with the Physical World (labeled 'access to facilities' with a double-headed arrow).
- Center:** Distributed, media-rich information.


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 This material is based upon work supported by the [National Science Foundation](#) under Grant No. IIS 0085951. Any opinions, findings, and conclusions or recommendations expressed in this material are those of the author(s) and do not necessarily reflect the views of the National Science Foundation.

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# Collaboratories at a Glance

- Collect a large set of collaboratories
  - We have identified 134 possible candidates
- Collect a basic set of information
- Note similarities and differences on both technical and social dimensions






Resources : Collaboratories at a Glance - Microsoft Internet Explorer - [Working Offline]

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[Click here to suggest a collaboratory](#)

Resources : Collaboratories at a Glance -- **Alphabetical**

<u>Project Name</u>	<u>Start Date</u>	<u>Primary Function</u>
A Toroidal LHC Apparatus (ATLAS)		
Alcator C-Mod Tokamak Fusion Research Project		
Alliance for Cellular Signaling (AfCS)	1999	Distributed Research Center
Arizona Telemedicine Program	1996	
Astrophysics Simulation Collaboratory (ASC)		
Baltimore Washington Collaboratory (BWC)	1996	
Biological Collaborative Research Environment (BioCoRE)	1998	Distributed Research Center
Biomedical Informatics Research Network (BIRN)	2001	Distributed Research Center
Botswana: BHP AIDS research		
<a href="#">Bugscope</a>	1999	Shared Instrument
Burn and Trauma Injury	2001	Distributed Research Center
Cell Functional Glycomics: Burn and Trauma, Cell Something Consortium		
Cell Migration Consortium (CMC)		Distributed Research Center
<a href="#">Center for Behavioral Neuroscience (CBN)</a>	1998	Distributed Research Center
<a href="#">Center for Innovative Learning Technologies (CILT)</a>	1997	Distributed Research Center
<a href="#">Chickscope</a>	1996	Shared Instrument
CLEO Collaboration		Shared Instrument
Cochrane Collaboratory		Distributed Research Center
Collaboratory for Annotation, Indexing and Retrieval of Digitized Historical Archive Material (COLLATE)	2000	Distributed Research Center
Collaboratory for High Performance Computing and Communications		
Collaboratory for Simulation and Modeling (CSM)	1994	Shared Instrument

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# In-depth

- SPARC/UARC
- GLR CFAR
- Bugscope
- EMSL
- NEESgrid
- InterMed
- GriPhyN
- iVDGL
- AfCS
- BIRN



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# Kinds of Collaboratories

- Research focus
  - Distributed Research Center
  - Shared Instrumentation
  - Community Data Systems
  - Open Community Contribution Systems
- Practice focus
  - Virtual Community of Practice
  - Virtual Learning Community
  - Expert Consultation



# Distributed Research Center

- Functions like a University research center, but at a distance.
- Most communication human-human
- Project is unified by a topic area of interest, and includes a number of joint projects in that area.
- No single product as the focus

- *Alliance for Cell Signaling*



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# Shared Instrument

- Increases access to a scientific instrument
- Often remote access to an expensive instrument
- Often supplemented with other technology to support communication
- *Keck observatory*



# Community Data System

- Information resource that is created, maintained, or improved by a distributed community
- Information is semi-public, of wide interest.
- *Zebrafish information network*



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# Open Community Contribution System

- Micro contributions to a project
- Modeled on open source software development

- *Open Mind Initiative*



- *NASA Ames Clickworkers*



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# Virtual Community of Practice

- A network of individuals who share a research area and communicate about it online
- Share news of professional interest, advice, techniques.
- Not focused on joint projects
- *Ocean US*





# Virtual Learning Community

- Main focus is on increasing the knowledge of the participants
  - Not to do original research
- Can be inservice or professional development
- *Ecology Circuit Collaboration*



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# Expert Consultation

- Provides increased access to an expert or set of experts
- The flow of information is mainly one way, rather than two way as in a distributed center

- *TeleInViVo*



# How they relate to each other

Shared  
Instrument

Community  
Data System

Open  
Community  
Contribution  
System

Distributed  
Research  
Center

Virtual  
Community  
Of Practice

Virtual  
Learning  
Community

Expert  
Consultation



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# Collaboratories evolve

- They start as one type and often migrate to include others as well
  - E.g. SPARC/UARC – shared instruments plus chat, then archives became a community data system and the beginnings of a distributed research center
  - E.g. Chickscope – shared instruments to community data system.



# The relationships

- Wisdom
- Knowledge
- Information
- Data
- The world

**Practice and Expertise**

**Distributed Research  
Centers**

**Community Systems**

**Shared Instruments**



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# What is Success?

- Use of the collaboratory tools
- Software technology
- Direct effects on the science
- Science careers
- Effects on learning, science education
- Inspiration for other collaboratories
- Learning about collaboratories in general
- Effects on funding, public perception



Notes on Measures of Collaboratory Success - Microsoft Internet Explorer

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### Measures of Success

Classes of Criteria	Specific Criteria
Use of the collaboratory tools	Designer/Builder demos it working
	Original target users use it with direct support
	Original target users use it unaided
	Original target users sustain its use
	New users try it successfully
	New users continue to use it
	Users complain when it is taken away (e.g., fails to work with new OS)
	Collaboratory moves from research prototype to production system
	Collaboratory is sustained
	Collaboratory project is refunded
Software technology	Software developed that is reused
	Lessons learned about technical issues
	Lessons were published
Direct effects on the science	Feasibility demonstrations for new forms of scientific work
	New forms of work are sustained
	Existing collaborations work more smoothly or quickly
	More collaborations are attempted
	New collaborations are formed
	Collaborations have greater geographic spread
	New discoveries are made as a result
	A big discovery is made
	Discoveries made more quickly
	A conceptual revolution in the science is enabled
	More jointly authored papers

Menu ready for use

Internet



# Factors That Affect Success

- SOC project has identified a large set of potential factors
- Here review a few that are clearly important
  - Not a complete list





# Collaboration readiness

- The community has to have a spirit of collaboration.
- You cannot *make* people collaborate through the technology.



# Collaboration Readiness

- Can a collaboratory be mandated by an external agency (e.g., funding source)?
  - NEESgrid – collaboratory capability as a condition of funding
- History of collaboration
  - High energy physics vs. earthquake engineering
- Science driven
  - AfCS
  - BIRN



# Technical readiness

- Infrastructure has to be sophisticated enough to accommodate the new technology
  - Technical
  - Social
- Users must be able to use the technology and understand how it will shape their work
- People can't make too big a leap

*SPARC*

*Africa Aids*

*Worm Community*



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# Social Ergonomics of Tools

- We are all familiar with traditional ergonomics
  - System design affects the behavior of the user when interacting with the system
- *Social* Ergonomics are a critical in systems that mediate communication
  - Characteristics of system design elicit changes in social behavior
- Details matter
  - Example: In videoconferencing, there is added latency in turn taking due to the network.
  - Hesitation in answering a question is a common cue people use to tell if someone is being dishonest

















# Apparent Height

- Apparently taller – more influential in a negotiation task
- Other candidates
  - Size
  - Volume (loudness)



# High quality



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# 1/3 spatial resolution



# 1/6 spatial resolution



# Ability to Detect Lying

- Changes as quality of video changes
- Other issues
  - Trust
  - Multi-national communication



# Incentives must be aligned

- Incentives must be carefully designed to encourage sustained participation
- Who has to do the work; who benefits (*Grudin, Orlikowski*)



# Incentives: Examples

- Goodwill
  - ZFIN
- Goodwill plus Karma points
  - Slashdot
- Required contribution for other things
  - GenBank
- Equivalent to a publication
  - Alliance for Cell Signaling





# Data Issues

- Metadata
- Provenance
- Persistence, archiving
- Rationale for transformations
  - NEESgrid, GriPhyN, iVDGL, AfCS, BIRN
- Details of size, usage – different software needs?
- What level of processing? Different disciplines may vary [D. Sonnenwald]
- Data sharing across jurisdictional boundaries – BIRN
  - IRB – data from humans
  - International



# Moving to Production Versions

- **Tensions between CS and domain users**
  - NEESgrid – “innovation vs. extrapolation”
  - GriPhyN & iVDGL
- **Moving beyond initial demo stages**
  - Slow adoption
    - InterMed
  - Sustaining the investment
    - NEESgrid – NEES consortium infrastructure set up in advance
    - GriPhyN, iVDGL – seeking a sustaining support process
    - BIRN
- **Incentives**
  - “build hardware” [J. Leigh]
- **Diffusion of Innovation literature**



# Management Issues Critical

- NEESgrid – management lags implementation
- InterMed – need for tight management
- GriPhyN & iVDGL – hiring project managers
- AfCS – charismatic management
- BIRN – governance manual; adding steering committee



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# Conclusions

- Success in science collaboratories a complex mix of social and technical factors
- Interface details can shape the character of the social interactions

